

## Claims

1. A polymer composition for radiation shielding comprising:  
about 1.2 to 15% at least one isocyanate monomer;  
about 1.0 to 14% at least one phenolic resin;  
about 0.2 to 1.0% at least one flame retardant compound; and  
about 80 to 96% depleted uranium, wherein the isocyanate monomer, phenolic resin, and depleted uranium of the composition are combined to form a homogeneous mixture prior to curing of the composition.
2. The polymer composition of claim 1 wherein the isocyanate monomer is an aromatic isocyanate.
3. The polymer composition of claim 1 wherein the phenolic resin is produced by the polycondensation of a phenol compound with formaldehyde.
4. The polymer composition of claim 1 wherein the depleted uranium is selected from the group consisting of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$ , and mixtures thereof.
5. The polymer composition of claim 1 further comprising a catalyst.
6. A polymer composition for radiation shielding comprising:  
about 1.2 to 15% at least one aromatic isocyanate monomer;  
about 1.0 to 14% at least one phenolic resin, the phenolic resin being produced by the polycondensation of a phenol compound with formaldehyde;  
about 80 to 96% depleted uranium selected from the group consisting of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof;  
about 0.2 to 1.0% at least one halogenated phosphate ester flame retardant and  
about 0 to 1.0% at least one catalyst;  
wherein the isocyanate monomer, phenolic resin, and depleted uranium of the composition are combined to form a homogeneous mixture prior to curing of the composition.
7. The polymer composition of claim 6 wherein the aromatic isocyanate monomer is diphenylmethane 4,4'-diisocyanate.
8. The polymer composition of claim 6 wherein the phenolic resin is produced by the polycondensation of phenol with formaldehyde.
9. The polymer composition of claim 6 wherein the catalyst is phenylpropyl pyridine.
10. The polymer composition of claim 6 wherein the halogenated phosphate ester flame retardant is Firemaster 836<sup>TM</sup> by Great Lakes Chemical Corp., West Lafayette, Indiana.
11. A polymer composition for radiation shielding comprising:  
about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the polycondensation of phenol with formaldehyde;

about 0.6% halogenated phosphate ester; and  
about 93.4% depleted uranium selected from the group consisting of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof;  
wherein the diphenylmethane 4,4'-diisocyanate, phenolic resin and depleted uranium of the composition are combined to form a homogeneous mixture prior to curing of the composition.

12. A polymer composition for radiation shielding comprising:  
about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the polycondensation of phenol with formaldehyde;  
about 93.25% depleted uranium selected from the group consisting of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof;  
about 0.6% halogenated phosphate ester and  
about 0.15% phenylpropyl pyridine;  
wherein the diphenylmethane 4,4'-diisocyanate, phenolic resin, depleted uranium and phenylpropyl pyridine of the composition are combined to form a homogeneous mixture prior to curing of the composition.

13. The process of making a polymer composition comprising:  
mixing about 1.2 to 15% at least one isocyanate monomer;  
about 1.0 to 14% phenolic resin;  
about 0.2 to 1.0% flame retardant compound; and  
about 80 to 96% depleted uranium, until a homogeneous mixture is formed; and  
allowing the homogeneous mixture to cure.

14. The process of making a polymer composition comprising:  
mixing about 1.2 to 15% at least one aromatic isocyanate monomer;  
about 1.0 to 14% at least one phenolic resin, the phenolic resin being produced by the polycondensation of a phenol with formaldehyde;  
about 80 to 96% depleted uranium selected from the group consisting of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof;  
about 0.2 to 1.0% halogenated phosphate ester flame retardant compound; and  
about 0 to 1.0% at least one catalyst until a homogeneous mixture is formed; and  
allowing the homogeneous mixture to cure.

15. The process of making a polymer composition comprising:  
mixing about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the polycondensation of phenol with formaldehyde;  
about 0.6% halogenated phosphate ester flame retardant compound and  
about 94% depleted uranium selected from the group consisting of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof, until a homogeneous mixture is formed; and  
allowing the homogeneous mixture to cure.

16. The process of making a polymer composition comprising:  
mixing about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde;  
about 93.25% depleted uranium selected from the group consisting of  
UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof;  
about 0.6% halogenated phosphate ester flame retardant compound and  
about 0.15% phenylpropyl pyridine until a homogeneous mixture is  
formed; and  
allowing the homogeneous mixture to cure.
17. A polymer composition for radiation shielding comprising:  
about 25 to 75% at least one isocyanate monomer;  
about 20 to 70% at least one phenolic resin; and  
about 3 to 10% at least one halogenated phosphate ester flame retardant  
compound, wherein the isocyanate monomer, phenolic resin, and the halogenated phosphate  
ester retardant compound of the composition are combined to form a homogeneous mixture prior  
to curing of the composition.
18. The polymer composition of claim 17 wherein the isocyanate monomer is an  
aromatic isocyanate.
19. The polymer composition of claim 17 wherein the phenolic resin is produced by  
the polycondensation of a phenol compound with formaldehyde.
20. The polymer composition of claim 17 further comprising a catalyst.
21. A polymer composition for radiation shielding comprising:  
about 25 to 75% at least one aromatic isocyanate monomer;  
about 20 to 70% at least one phenolic resin, the phenolic resin being produced by  
the polycondensation of a phenol compound with formaldehyde;  
about 3 to 10% at least one halogenated phosphate ester flame retardant and  
about 0 to 1.0% at least one catalyst;  
wherein the isocyanate monomer, phenolic resin, halogenated phosphate ester  
retardant compound and the catalyst of the composition are combined to form a homogeneous  
mixture prior to curing of the composition.
22. The polymer composition of claim 21 wherein the aromatic isocyanate monomer  
is diphenylmethane 4,4'-diisocyanate.
23. The polymer composition of claim 21 wherein the phenolic resin is produced by  
the polycondensation of phenol with formaldehyde.
24. The polymer composition of claim 21 wherein the catalyst is phenylpropyl  
pyridine.
25. The polymer composition of claim 21 wherein the halogenated phosphate ester  
retardant is Firemaster 836™ by Great Lakes Chemical Corp., West Lafayette, Indiana.

26. A polymer composition for radiation shielding comprising:  
about 40% diphenylmethane 4,4'-diisocyanate;  
about 54% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde; and  
about 6% halogenated phosphate ester retardant;  
wherein the diphenylmethane 4,4'-diisocyanate, phenolic resin and halogenated  
phosphate ester of the composition are combined to form a homogeneous mixture prior to curing  
of the composition.

27. A polymer composition for radiation shielding comprising:  
about 40% diphenylmethane 4,4'-diisocyanate;  
about 53.85% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde;  
about 6% halogenated phosphate ester; and  
about 0.15% phenylpropyl pyridine;  
wherein the diphenylmethane 4,4'-diisocyanate, phenolic resin, halogenated  
phosphate ester and phenylpropyl pyridine of the composition are combined to form a  
homogeneous mixture prior to curing of the composition.

28. The process of making a polymer composition comprising:  
mixing about 25-75% at least one isocyanate monomer;  
about 20-70% phenolic resin; and  
about 3 to 10% halogenated phosphate ester retardant compound, until a  
homogeneous mixture is formed; and  
allowing the homogeneous mixture to cure.

29. The process of making a polymer composition comprising:  
mixing about 1.2 to 15% at least one aromatic isocyanate monomer;  
about 1.0 to 14% at least one phenolic resin, the phenolic resin being  
produced by the polycondensation of a phenol with formaldehyde;  
about 0.2 to 1.0% at least one halogenated phosphate ester;  
about 80 to 96% depleted uranium; and  
about 0 to 1.0% at least one catalyst until a homogeneous mixture is  
formed; and  
allowing the homogeneous mixture to cure.

30. The process of making a polymer composition comprising:  
mixing about 40% diphenylmethane 4,4'-diisocyanate;  
about 54% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde; and  
about 6% halogenated phosphate ester; and  
allowing the homogeneous mixture to cure.

31. The process of making a polymer composition comprising:
  - mixing about 40% diphenylmethane 4,4'-diisocyanate;
  - about 53.85% phenolic resin, the phenolic resin being produced by the polycondensation of phenol with formaldehyde;
  - about 6% halogenated phosphate ester; and
  - about 0.15% phenylpropyl pyridine until a homogeneous mixture is formed; and
  - allowing the homogeneous mixture to cure.
32. The process of making a polymer composition comprising:
  - mixing about 2.4% diphenylmethane 4,4'-diisocyanate;
  - about 3.6% phenolic resin, the phenolic resin being produced by the polycondensation of phenol with formaldehyde; and
  - about 0.6% halogenated phosphate ester;
  - about 93.4% depleted uranium selected from the group consisting of  $\text{UO}_3$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof; and
  - allowing the homogeneous mixture to cure.
33. The process of making a polymer composition comprising:
  - mixing about 2.4% diphenylmethane 4,4'-diisocyanate;
  - about 3.6% phenolic resin, the phenolic resin being produced by the polycondensation of phenol with formaldehyde;
  - about 0.6% halogenated phosphate ester;
  - about 93.25% depleted uranium selected from the group consisting of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof; and
  - about 0.15% phenylpropyl pyridine until a homogeneous mixture is formed; and
  - allowing the homogeneous mixture to cure.
34. A method for shielding a surface from radiation comprising:
  - preparing a radiation shielding polymer solution;
  - applying the polymer solution to the surface to be shielded; and
  - allowing the polymer solution that has been applied on the surface to cure.
35. The method of claim 34 wherein the polymer solution is applied by a spraying means.
36. The method of claim 34 wherein the polymer solution is prepared by:
  - mixing about 25 to 75% at least one isocyanate monomer;
  - about 20 to 70% phenolic resin;
  - about 3 to 10% halogenated phosphate ester retardant compound; and
  - about 0 to 1.0% catalyst, until a homogeneous mixture is formed.
37. The method of claim 34 wherein the polymer solution is prepared by:
  - mixing about 25 to 75% at least one aromatic isocyanate monomer;
  - about 20-70% at least one phenolic resin, the phenolic resin being produced by the polycondensation of a phenol with formaldehyde;

about 3 to 10% at least one halogenated phosphate ester retardant compound; and  
about 0 to 1.0% at least one catalyst, until a homogeneous mixture is formed.

38. The method of claim 34 wherein the polymer solution is prepared by:  
mixing about 40% diphenylmethane 4,4'-diisocyanate;  
about 53.85 to 54% phenolic resin, the phenolic resin being produced by the polycondensation of phenol with formaldehyde;  
about 6% halogenated phosphate ester; and  
about 0-0.15 pyridine catalyst, until a homogeneous mixture is formed.
39. The method of claim 34 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% at least one isocyanate monomer;  
about 1.0 to 14% phenolic resin;  
about 0.2 to 1.0% halogenated phosphate ester retardant compound;  
about 80 to 96% depleted uranium; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.
40. The method of claim 34 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% diphenylmethane 4,4'-diisocyanate;  
about 1.0 to 14% phenolic resin, the phenolic resin being produced by the polycondensation of phenol with formaldehyde; and  
about 0.2 to 1.0% halogenated phosphate ester;  
about 80-96% depleted uranium selected from the group consisting of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof; and  
about 0 to 0.15% pyridine catalyst, until a homogeneous mixture is formed.
41. The method of claim 34 wherein the polymer solution is prepared by:  
mixing about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the polycondensation of phenol with formaldehyde;  
about 0.6% halogenated phosphate ester;  
about 93.25 to 93.4% depleted uranium selected from the group consisting of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof; and  
about 0 to 0.15% phenylpropyl pyridine, until a homogeneous mixture is formed.

42. A method for containing radiation within a room, the room having structural components which make up the room, the structural components having interior surfaces, the method comprising:  
preparing a radiation shielding polymer solution;  
spraying the polymer solution on the interior surfaces of the structural components of the room; and  
allowing the sprayed polymer solution to cure to a polymer film.

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43. The method of claim 42 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one isocyanate monomer;  
about 20 to 70% phenolic resin;  
about 3 to 10% halogenated phosphate ester retardant compound; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.
44. The method of claim 42 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one aromatic isocyanate monomer;  
about 20-70% at least one phenolic resin, the phenolic resin being  
produced by the polycondensation of a phenol with formaldehyde;  
about 3 to 10% at least one halogenated phosphate ester retardant  
compound; and  
about 0 to 1.0% at least one catalyst, until a homogeneous mixture is  
formed.
45. The method of claim 42 wherein the polymer solution is prepared by:  
mixing about 40% diphenylmethane 4,4'-diisocyanate;  
about 53.85 to 54% phenolic resin, the phenolic resin being produced by  
the polycondensation of phenol with formaldehyde;  
about 6% halogenated phosphate ester; and  
about 0-0.15 pyridine catalyst, until a homogeneous mixture is formed.
46. The method of claim 42 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% at least one isocyanate monomer;  
about 1.0 to 14% phenolic resin;  
about 0.2 to 1.0% halogenated phosphate ester retardant compound;  
about 80 to 96% depleted uranium; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.
47. The method of claim 42 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% diphenylmethane 4,4'-diisocyanate;  
about 1.0 to 14% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde; and  
about 0.2 to 1.0% halogenated phosphate ester;  
about 80-96% depleted uranium selected from the group consisting of  
UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof; and  
about 0 to 0.15% pyridine catalyst, until a homogeneous mixture is  
formed.
48. The method of claim 42 wherein the polymer solution is prepared by:  
mixing about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde;  
about 0.6% halogenated phosphate ester;  
about 93.25 to 93.4% depleted uranium selected from the group consisting  
of UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof; and

about 0 to 0.15% phenylpropyl pyridine, until a homogeneous mixture is formed.

49. A method of containing radiation on radiation contaminated surfaces comprising:  
preparing a radiation shielding polymer solution;  
spraying the polymer solution on the contaminated surfaces; and  
allowing the sprayed polymer solution to cure to a polymer film.
50. The method of claim 49 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one isocyanate monomer;  
about 20 to 70% phenolic resin;  
about 3 to 10% halogenated phosphate ester retardant compound; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.
51. The method of claim 49 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one aromatic isocyanate monomer;  
about 20-70% at least one phenolic resin, the phenolic resin being  
produced by the polycondensation of a phenol with formaldehyde;  
about 3 to 10% at least one halogenated phosphate ester retardant  
compound; and  
about 0 to 1.0% at least one catalyst, until a homogeneous mixture is  
formed.
52. The method of claim 49 wherein the polymer solution is prepared by:  
mixing about 40% diphenylmethane 4,4'-diisocyanate;  
about 53.85 to 54% phenolic resin, the phenolic resin being produced by  
the polycondensation of phenol with formaldehyde;  
about 6% halogenated phosphate ester; and  
about 0-0.15 pyridine catalyst, until a homogeneous mixture is formed.
53. The method of claim 49 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% at least one isocyanate monomer;  
about 1.0 to 14% phenolic resin;  
about 0.2 to 1.0% halogenated phosphate ester retardant compound;  
about 80 to 96% depleted uranium; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.
54. The method of claim 49 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% diphenylmethane 4,4'-diisocyanate;  
about 1.0 to 14% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde; and  
about 0.2 to 1.0% halogenated phosphate ester;  
about 80-96% depleted uranium selected from the group consisting of  
UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof; and  
about 0 to 0.15% pyridine catalyst; until a homogeneous mixture is  
formed.



55. The method of claim 49 wherein the polymer solution is prepared by:  
mixing about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde;  
about 0.6% halogenated phosphate ester;  
about 93.25 to 93.4% depleted uranium selected from the group consisting  
of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof; and  
about 0 to 0.15% phenylpropyl pyridine, until a homogeneous mixture is  
formed.
56. A method of molding radiation shielding objects comprising:  
preparing an uncured radiation shielding polymer;  
molding the uncured polymer solution into a desired object; and  
allowing the polymer solution to cure to a solid.
57. The method of claim 56 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one isocyanate monomer;  
about 20 to 70% phenolic resin;  
about 3 to 10% halogenated phosphate ester retardant compound; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.
58. The method of claim 56 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one aromatic isocyanate monomer;  
about 20-70% at least one phenolic resin, the phenolic resin being  
produced by the polycondensation of a phenol with formaldehyde;  
about 3 to 10% at least one halogenated phosphate ester retardant  
compound; and  
about 0 to 1.0% at least one catalyst, until a homogeneous mixture is  
formed.
59. The method of claim 56 wherein the polymer solution is prepared by:  
mixing about 40% diphenylmethane 4,4'-diisocyanate;  
about 53.85 to 54% phenolic resin, the phenolic resin being produced by  
the polycondensation of phenol with formaldehyde;  
about 6% halogenated phosphate ester; and  
about 0-0.15 pyridine catalyst, until a homogeneous mixture is formed.
60. The method of claim 56 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% at least one isocyanate monomer;  
about 1.0 to 14% phenolic resin;  
about 0.2 to 1.0% halogenated phosphate ester retardant compound;  
about 80 to 96% depleted uranium; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.

61. The method of claim 56 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% diphenylmethane 4,4'-diisocyanate;  
about 1.0 to 14% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde; and  
about 0.2 to 1.0% halogenated phosphate ester;  
about 80-96% depleted uranium selected from the group consisting of  
UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof; and  
about 0 to 0.15% pyridine catalyst, until a homogeneous mixture is  
formed.

62. The method of claim 56 wherein the polymer solution is prepared by:  
mixing about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde;  
about 0.6% halogenated phosphate ester;  
about 93.25 to 93.4% depleted uranium selected from the group consisting  
of UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof; and  
about 0 to 0.15% phenylpropyl pyridine, until a homogeneous mixture is  
formed.

63. The method of claim 56 wherein the method of molding is compression molding.

64. A method for immobilizing and containing radioactive waste comprising:  
preparing a polymer solution;  
mixing the polymer solution with the radioactive waste to be immobilized and  
contained until a homogeneous mixture is formed; and  
allowing the homogeneous mixture to cure to a solid.

65. The method of claim 64 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one isocyanate monomer;  
about 20 to 70% phenolic resin;  
about 3 to 10% halogenated phosphate ester retardant compound; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.

66. The method of claim 64 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one aromatic isocyanate monomer;  
about 20-70% at least one phenolic resin, the phenolic resin being  
produced by the polycondensation of a phenol with formaldehyde;  
about 3 to 10% at least one halogenated phosphate ester retardant  
compound; and  
about 0 to 1.0% at least one catalyst, until a homogeneous mixture is  
formed.

67. The method of claim 64 wherein the polymer solution is prepared by:  
mixing about 40% diphenylmethane 4,4'-diisocyanate;  
about 53.85 to 54% phenolic resin, the phenolic resin being produced by  
the polycondensation of phenol with formaldehyde;  
about 6% halogenated phosphate ester; and  
about 0-0.15 pyridine catalyst, until a homogeneous mixture is formed.
68. The method of claim 64 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% at least one isocyanate monomer;  
about 1.0 to 14% phenolic resin;  
about 0.2 to 1.0% halogenated phosphate ester retardant compound;  
about 80 to 96% depleted uranium; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.
69. The method of claim 64 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% diphenylmethane 4,4'-diisocyanate;  
about 1.0 to 14% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde; and  
about 0.2 to 1.0% halogenated phosphate ester;  
about 80-96% depleted uranium selected from the group consisting of  
UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof; and  
about 0 to 0.15% pyridine catalyst, until a homogeneous mixture is  
formed.
70. The method of claim 64 wherein the polymer solution is prepared by:  
mixing about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde;  
about 0.6% halogenated phosphate ester;  
about 93.25 to 93.4% depleted uranium selected from the group consisting  
of UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof; and  
about 0 to 0.15% phenylpropyl pyridine; until a homogeneous mixture is  
formed.
71. A method for immobilizing and containing metal ion waste comprising:  
selecting anions to bond with the metal ions, the selection based on the solubility  
product constant of the anions;  
introducing the anions into the metal ion waste;  
preparing a polymer solution;  
mixing the waste and polymer solution until a homogeneous mixture is formed;  
and  
allowing the homogeneous mixture to cure.
72. The method of claim 71 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one isocyanate monomer;  
about 20 to 70% phenolic resin;  
about 3 to 10% halogenated phosphate ester retardant compound; and

about 0 to 1.0% catalyst, until a homogeneous mixture is formed.

73. The method of claim 71 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one aromatic isocyanate monomer;  
about 20-70% at least one phenolic resin, the phenolic resin being  
produced by the polycondensation of a phenol with formaldehyde;  
about 3 to 10% at least one halogenated phosphate ester retardant  
compound; and  
about 0 to 1.0% at least one catalyst, until a homogeneous mixture is  
formed.

74. The method of claim 71 wherein the polymer solution is prepared by:  
mixing about 40% diphenylmethane 4,4'-diisocyanate;  
about 53.85 to 54% phenolic resin, the phenolic resin being produced by  
the polycondensation of phenol with formaldehyde;  
about 6% halogenated phosphate ester; and  
about 0-0.15 pyridine catalyst, until a homogeneous mixture is formed.

75. The method of claim 71 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% at least one isocyanate monomer;  
about 1.0 to 14% phenolic resin;  
about 0.2 to 1.0% halogenated phosphate ester retardant compound;  
about 80 to 96% depleted uranium; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.

76. The method of claim 71 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% diphenylmethane 4,4'-diisocyanate;  
about 1.0 to 14% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde; and  
about 0.2 to 1.0% halogenated phosphate ester;  
about 80-96% depleted uranium selected from the group consisting of  
UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof; and  
about 0 to 0.15% pyridine catalyst, until a homogeneous mixture is  
formed.

77. The method of claim 71 wherein the polymer solution is prepared by:  
mixing about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde;  
about 0.6% halogenated phosphate ester;  
about 93.25 to 93.4% depleted uranium selected from the group consisting  
of UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof; and  
about 0 to 0.15% phenylpropyl pyridine, until a homogeneous mixture is  
formed.

78. A method for reducing the volume of and containing radioactive waste comprising:  
removing organic material from the radioactive waste to form a waste residue;  
drying the waste residue; and  
encapsulating the dried waste residue within an uncured polymer solution.
79. The method of claim 78 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one isocyanate monomer;  
about 20 to 70% phenolic resin;  
about 3 to 10% halogenated phosphate ester retardant compound; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.
80. The method of claim 78 wherein the polymer solution is prepared by:  
mixing about 25 to 75% at least one aromatic isocyanate monomer;  
about 20-70% at least one phenolic resin, the phenolic resin being  
produced by the polycondensation of a phenol with formaldehyde;  
about 3 to 10% at least one halogenated phosphate ester retardant  
compound; and  
about 0 to 1.0% at least one catalyst, until a homogeneous mixture is  
formed.
81. The method of claim 78 wherein the polymer solution is prepared by:  
mixing about 40% diphenylmethane 4,4'-diisocyanate;  
about 53.85 to 54% phenolic resin, the phenolic resin being produced by  
the polycondensation of phenol with formaldehyde;  
about 6% halogenated phosphate ester; and  
about 0-0.15 pyridine catalyst, until a homogeneous mixture is formed.
82. The method of claim 78 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% at least one isocyanate monomer;  
about 1.0 to 14% phenolic resin;  
about 0.2 to 1.0% halogenated phosphate ester retardant compound;  
about 80 to 96% depleted uranium; and  
about 0 to 1.0% catalyst, until a homogeneous mixture is formed.
83. The method of claim 78 wherein the polymer solution is prepared by:  
mixing about 1.2 to 15% diphenylmethane 4,4'-diisocyanate;  
about 1.0 to 14% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde; and  
about 0.2 to 1.0% halogenated phosphate ester;  
about 80-96% depleted uranium selected from the group consisting of  
UO<sub>3</sub>, UO<sub>2</sub>, U<sub>3</sub>O<sub>8</sub> and mixtures thereof; and  
about 0 to 0.15% pyridine catalyst, until a homogeneous mixture is  
formed.

84. The method of claim 78 wherein the polymer solution is prepared by:  
mixing about 2.4% diphenylmethane 4,4'-diisocyanate;  
about 3.6% phenolic resin, the phenolic resin being produced by the  
polycondensation of phenol with formaldehyde;  
about 0.6% halogenated phosphate ester;  
about 93.25 to 93.4% depleted uranium selected from the group consisting  
of  $\text{UO}_3$ ,  $\text{UO}_2$ ,  $\text{U}_3\text{O}_8$  and mixtures thereof; and  
about 0 to 0.15% phenylpropyl pyridine, until a homogeneous mixture is  
formed.

85. A method for reducing the volume of and containing radioactive waste  
comprising:  
removing organic matter from the radioactive waste to form a waste residue;  
drying the waste residue; and  
placing the dried waste residue in a radiation shielded container.

86. The method of claim 85 further comprising treating any gases produced during  
the removing and drying steps.

87. The method of claim 85 further comprising pyrolyzing the dried waste residue to  
yield metal oxides.

88. A method for reducing the volume of and containing radioactive waste  
comprising:  
agitating the waste until a homogeneous mixture is formed;  
pumping the resulting waste mixture into a thermal desorption unit;  
reducing the pressure within the thermal desorption unit;  
subjecting the waste mixture to low temperature thermal desorption to remove  
organic matter and water vapor, until a resulting solid waste residue is dry;  
pyrolyzing the solid waste residue to yield metal oxides;  
directing gases produced by pyrolysis to an off gas treatment system for  
scrubbing;  
condensing water vapor formed during pyrolysis;  
removing metal ions contained in the condensed water by reverse osmosis; and  
placing the remaining solid waste residue in a radiation shielded container.

89. A radiation shielded container for storing radioactive material comprising:  
an outer jacket portion;  
an inner lining portion, wherein the inner lining portion is positioned relative  
to the outer jacket portion to form a substantially uniform void between the inner lining portion and  
the outer jacket portion;  
a waste storage compartment defined by the inner lining portion; and  
a radiation shielding polymer layer located within the void between the inner  
lining portion and the outer jacket portion.

90. The radiation shielded container of claim 89 further including means to introduce the shielding polymer layer into the void between the inner lining portion and the outer jacket portion.

91. The radiation shielded container of claim 89 further including means to introduce the radioactive material to be stored into the waste storage compartment.

92. The radiation shielded container of claim 89 further including means to prevent excessive pressure within the waste storage compartment.

93. The radiation shielded container of claim 89 further including means to cool the radiation shielded container.

94. The radiation shielded container of claim 89 further including means to prevent corrosion of the radiation shielded container.

95. The radiation shielded container of claim 89 wherein the outer jacket portion and the inner lining portion are made of stainless steel.

96. The radiation shielded container of claim 89 wherein the radiation shielding polymer is comprised of:  
about 25 to 75% at least one isocyanate monomer;  
about 20 to 70% at least one phenolic resin;  
about 3 to 10% at least one halogenated phosphate ester retardant compound; and  
about 0 to 1.0% at least one catalyst.

97. The radiation shielded container of claim 93 wherein the means to cool includes at least one heat removal channel located within the void between the inner lining portion and the outer jacket portion through which air flows thereby removing heat from the interior of the waste storage compartment.

98. The radiation shielded container of claim 92 wherein the means to prevent excessive pressure within the waste storage compartment includes a pressure release valve.

99. The radiation shielded container of claim 94 wherein the means to prevent corrosion of the radiation shielded container includes a sacrificial electrode.

100. A radiation shielded container for storing radioactive material comprising:  
an outer jacket portion;  
an inner lining portion, the inner lining portion being fixedly positioned relative to the outer jacket portion to form a substantially uniform void between the inner lining portion and the outer jacket portion;  
a waste storage compartment defined by the inner lining portion;  
a radiation shielding polymer layer located within the void between the inner lining portion and the outer jacket portion; and  
a fill nozzle to introduce the radioactive material to be stored into the waste storage compartment.

101. The radiation shielded container of claim 100 further including a polymer fill aperture to introduce the shielding polymer layer into the void between the inner lining portion and the outer jacket portion.

102. The radiation shielded container of claim 100 further including at least one pressure release valve to prevent excessive pressure within the waste storage compartment.

103. The radiation shielded container of claim 100 further including at least one heat removal channel through which air flows thereby removing heat from the interior of the waste storage compartment to cool the radiation shielded container.

104. The radiation shielded container of claim 100 further including at least one sacrificial electrode to prevent corrosion of the radiation shielded container.

105. The radiation shielded container of claim 100 wherein the radiation shielding polymer is comprised of:  
about 25 to 75% at least one isocyanate monomer;  
about 20 to 70% at least one phenolic resin;  
about 3 to 10% at least one halogenated phosphate ester retardant compound; and  
about 0 to 1.0% at least one catalyst.

106. A radiation shielding container for storing low level radioactive material comprising:  
a body portion, the body portion including a wall portion and a base, the wall portion and base having interior surfaces defining a waste storage compartment;  
a cover portion having an interior surface;  
a radiation shielding polymer layer formed on the interior surfaces of the cover portion and the body portion; and  
means to secure the cover portion to the body portion.

107. The radiation shielding container of claim 106 wherein the body portion and the cover portion are made of stainless steel.

108. The radiation shielding container of claim 106 wherein the radiation shielding polymer is comprised of:  
about 25 to 75% at least one isocyanate monomer;  
about 20 to 70% at least one phenolic resin;  
about 3 to 10% at least one halogenated phosphate ester retardant compound; and  
about 0 to 1.0% at least one catalyst.

109. The radiation shielding container of claim 106 wherein the means to secure the cover portion to the body portion includes at least one fastening member.

110. A radiation shielding container for storing low level radioactive material comprising:  
a body portion, the body portion including a wall portion and a base, the wall portion and base having interior surfaces defining a waste storage compartment;  
a cover portion, the cover portion having an interior surface;



a radiation shielding polymer layer formed by spraying a radiation shielding polymer composition on the interior surfaces of the cover portion and the body portion; and at least one fastening member to secure the cover portion to the body portion.

111. The radiation shielding container of claim 110 wherein the radiation shielding polymer is comprised of:

about 25 to 75% at least one isocyanate monomer;

about 20 to 70% at least one phenolic resin;

about 3 to 10% at least one halogenated phosphate ester retardant compound; and

about 0 to 1.0% at least one catalyst.

112. A radiation shielding container for storing at least one canister containing radioactive material comprising:

an outer jacket portion;

an inner lining portion, the inner lining portion being fixedly positioned relative to the outer jacket portion to form a substantially uniform void between the inner lining portion and the outer jacket portion;

a canister storage compartment defined by the inner lining portion; and

a radiation shielding polymer layer located within the void between the inner lining portion and the outer jacket portion.

113. The radiation shielding container of claim 112 further including means to introduce the shielding polymer layer into the void between the inner lining portion and the outer jacket portion.

114. The radiation shielding container of claim 112 further including means to secure the at least one canister within the canister storage compartment.

115. The radiation shielding container of claim 112 further including means to cool the radiation shielded container.

116. The radiation shielding container of claim 112 further including means to prevent corrosion of the radiation shielded container.

117. The radiation shielded container of claim 112 wherein the outer jacket portion and the inner lining portion are made of metal.

118. The radiation shielding container of claim 112 wherein the radiation shielding polymer layer is comprised of:

about 25 to 75% at least one isocyanate monomer;

about 20 to 70% at least one phenolic resin;

about 3 to 10% at least one halogenated phosphate ester retardant compound; and

about 0 to 1.0% at least one catalyst.

119. The radiation shielding container of claim 115 wherein the means to cool includes at least one heat vent penetrating the outer jacket portion and at least a portion of the polymer layer in a non-linear manner for allowing air to exit therethrough.

120. The radiation shielding container of claim 116 wherein the means to prevent corrosion of the radiation shielded container includes a sacrificial electrode.

121. The radiation shielding container of claim 112 wherein said outer jacket portion and said inner lining portion form a cover portion for said container.

122. The radiation shielding container of claim 121 wherein said cover portion is removable from the remainder of said container.

123. The radiation shielding container of claim 112 including a cover portion, said cover portion having an outer jacket portion and an inner lining portion, the inner lining portion being fixedly positioned relative to the outer jacket portion to form a substantially uniform void between the inner lining portion and the outer jacket portion of said cover portion and a radiation shielding polymer layer located within the void between the inner lining portion and the outer jacket portion of said cover portion.

124. The radiation shielding container of claim 114 wherein said means to secure the at least one canister includes at least one grate positioned within the canister storage compartment.

125. The radiation shielding container of claim 114 wherein said means to secure the at least one canister includes at least one canister sleeve positioned and located within the canister storage compartment for receiving the bottom portion of the at least one canister.

126. The radiation shielding container of claim 123 wherein said cover portion includes a grate for securing the top portion of the at least one canister when the at least one canister is positioned within the canister storage compartment.

127. A radiation shielding container for storing radioactive material comprising:  
a body portion having an outer jacket portion and an inner lining portion, said inner lining portion being positioned relative to said outer jacket portion to form a substantially uniform void between said inner lining portion and said outer jacket portion;  
a cover portion having an outer jacket portion and an inner lining portion, the inner lining portion of said cover portion being positioned relative to the outer jacket portion of said cover portion so as to form a substantially uniform void therebetween;  
a canister storage compartment defined by the inner lining portion of said body portion; and  
a radiation shielding polymer layer located within the void between the inner lining portion and the outer jacket portion of said body and cover portions.

128. The radiation shielding container of claim 127 wherein said cover portion is removably attachable to said body portion.

129. The radiation shielding container of claim 127 wherein said cover portion is pivotally attachable to said body portion.

130. The radiation shielding container of claim 127 including at least one polymer fill aperture to introduce the shielding polymer layer into the void between the inner lining portion and the outer jacket portion of said body and cover portions.

131. The radiation shielding container of claim 127 including at least one heat vent penetrating the outer jacket portion and at least a portion of the polymer layer associated with said body portion.

132. The radiation shielding container of claim 127 including at least one sacrificial electrode to prevent corrosion of the radiation shielding container.

133. The radiation shielding container of claim 127 wherein the radiation shielding polymer is comprised of:

about 25 to 75% at least one isocyanate monomer;

about 20 to 70% at least one phenolic resin;

about 3 to 10% at least one halogenated phosphate ester retardant compound; and

about 0 to 1.0% at least one catalyst.

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